DESCRIPTION OF DRAWINGS

paragraph5.

Fig 1a and Fig 1b: These are graphical representations highlighting the difference between roof vent systems that release/relieve or equalize a pressure difference and my system, which actually limits the possible magnitude of the pressure difference across a roof.

Fig 2: Illustrates air movement above and below a roof.

Fig 3: Illustrates the forces acting on a roof.

Fig 4a through 4f: These figures outline the design of the preferred vent type.

Fig 5: Illustrates a step down profile roof.

Fig 6a: Illustration of the angle at which pressure acts against the interior of a roof.

Fig 6b: Illustration of the weight versus pressure angle of action on a roof.

Fig 7: Graphical representation of a useful interior/exterior pressure change relationship.

Fig 8: Graphical representation of straight line pressure change.

Fig 9: Graphical demonstration of how this applies to non-linear pressure change.

Fig 10a through 10d: Illustrations highlighting how the venting area must be just sufficient to evacuate air from each room of a building.

Fig 11: Illustration of how wind shear will affect the venting density.

Fig 12: Picture of vents spread evenly across the roof area.

Fig 13: Diagram illustrating the fact that when the wind blows from certain directions only a portion of the roof may be exposed to high wind exerting a venturi effect.

ARGUMENTS / PROSECUTION

Addressing the issue of patentability, I would like to outline what I understand the criteria for the grant of a patent to be. I will then explain how I see my invention fulfilling those criteria. Finally, I will compare my invention to the prior art that I have found in order to highlight the differences.

To be patentable in the U.S. an invention must be new, useful, and unobvious from the prior art. A utility patent must fit into one of four categories:

1) A process
2) A machine
3) An article of manufacture
4) Composition of matter

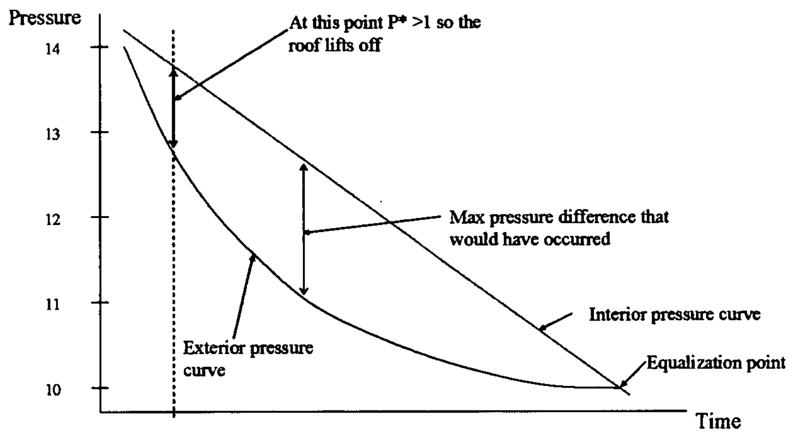
A process can also include a new method of making or using something already known in the other categories. My invention I believe can be looked at as a new method of using something already known in another category. Previously, vents have been used for the purpose of equalizing pressure. Several patents have been written and granted for a variety of vent designs that act to equalize or relieve pressure differences across a roof. No one however, has made use of a vent's ability to limit the maximum pressure difference that can occur.

I am applying for the grant of patent rights for a roof vent system. The new and useful thing which this system achieves, is the prevention of a pressure difference greater than a specified value across the roof, (i.e. between the interior and exterior of the building) and thus the prevention of roof loss. (The specified value is set so as to be lower than the pressure difference needed to lift off the roof). It is important to note that it is only as a vent system, (an entity in itself) installed using specific parameters that the objective of the invention can be achieved.

The use of venting in the roof of a building to equalize pressure is not new. There are several patents that I have found in my search which deal with this. (Title pages and abstract are enclosed in accompanying envelope). In all cases they have as their stated objective the equalization or relief of a pressure difference between the interior and exterior of the roof. I stress again that this is distinctly different from what my roof vent system achieves. Any hole such as a chimney flue or even a crack in a roof will allow for the equalization of pressure eventually. It will not necessarily however, prevent a pressure difference that is sufficient to lift off the roof, from developing. (This pressure difference is quantified by measuring the weight/area of the roof, the tensile strength of the roof material, and the tensile strength of the connections attaching the roof to the walls.)

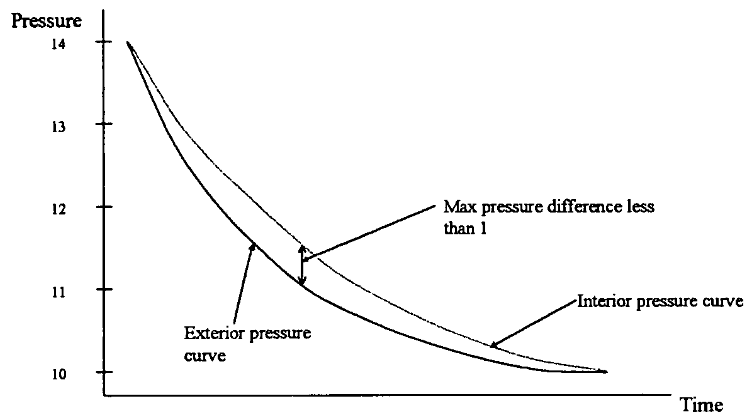
Graphical representation of the distinction between using a vent to equalize pressure and my vent system which prevents a specific pressure difference from occurring (arbitrary values and units used)

Use of vents to equalize pressure



Any pressure difference greater than 1 unit has been shown sufficient to lift off the roof. It can be seen that as soon as the pressure difference became greater than 1 the roof blew off. Equalization of pressure through venting would hypothetically have been reached if the roof had remained on. As it happens equalization occurred much sooner (as soon as the roof came off).

Use of vents to limit the pressure difference across a roof



Again, let it be accepted that roof lift off (loss) occurs at 1 unit pressure difference. At no time is a pressure difference allowed to occur across the roof which is greater than 1. Thus the roof will not lift off.

To ensure this relationship between the two curves, a calculation that takes data about the worst-case scenario pressure change above a roof, the volume of the building in question and various other parameters is used. The resulting equations generate a value for the surface area of open roof venting required to ensure that the interior and exterior pressure curves maintain acceptable relative positions. No equations of this nature are evident in the prior art that I have uncovered. This fact highlights the claim that my invention is new and distinct from the prior art, because it is only through the use of such equations that the ability of a vent to limit a pressure difference actually becomes useful. Thus, prior art showed an appreciation of a vents ability to equalize pressure, however no understanding of the fact that a vent may be used to limit a pressure difference is in evidence.

In summary, my arguments are that:

1. A roof vent system that prevents roof loss due to high winds is certainly useful.
2. It is new as far as any prior art that I have uncovered. The use of vents to equalize or relieve, pressure is not new, but the use of a roof vent system to prevent a pressure difference greater than a specified value across a roof is new.
3. I feel that once this has been explained to someone it should be obvious. However, I think that everything is 'obvious' once one has had it explained and

understands it. The best argument for not being obvious is probably that if this invention is very useful, and it has not been patented or implemented anywhere, then it cannot be all that obvious.

Rebuttal

With respect to the rejection of claims 1 and 2 under 35 U.S.C. 102(b) as being clearly anticipated by Babin, I would disagree and offer the following explanation and highlighted comparison.

I would say that the ultimate objectives of parts of Babin and myself are very similar to the point that they are essentially the same (the same as far as objective but not achievement of that objective). Both of us are trying to prevent roof loss in buildings subjected to high wind events, where differences in pressure may develop across a roof. There is however, a crucial subtlety between what our two different systems achieve and the design parameters that therefore go into achieving these objectives.

Babin uses a vent system to 'relieve' or 'release' or 'equalize' pressure. My vent system is designed specifically to 'limit' the pressure difference that can occur across a roof. This is a totally distinct and different objective. (See figs 1a and 1b which illustrate this in graph fashion)

Babin's system is simply an unspecified area of vents put in a roof to 'release' or 'relieve' or 'equalize' a pressure differential. This makes no attempt to place a limit on the pressure difference that can occur. Any hole in the roof, such as a chimney, bathroom vent or just a crack will achieve the same thing, a release of pressure. Release of pressure does not prevent roof loss. Only a limitation of pressure difference to a specified value will prevent roof loss.

My roof vent system is built to the parameters indicated by the equations that I have included. These equations link the worst-case scenario pressure change above a roof with the volume of the building to specify a vent system that has the area of venting required for that specific structure. The system only works/achieves its objective if it is built to these parameters. And it is a system, a roof vent system that achieves an objective that is different and distinct from the claims of Babin's system.

It is my understanding that the equations that I have put forward are not patentable, however their presence in my submission demonstrates a crucial fact. Without these or similar calculations you cannot build a roof vent system that limits the pressure difference across a roof. The system must be built based on the dictates of these equations in order to actually work. I have not found any previous art that demonstrates equations of this nature. It is an irrefutable fact of physics that in order to prevent roof loss due to a pressure differential across a roof, you must <u>limit</u> the pressure differential that can occur to a set value. Without this limitation you cannot prevent roof loss and without equations

you cannot effect this limitation. Therefore absence of equations in the prior art is a tell tale sign that it does not and cannot achieve the same objectives as my invention. This is a further indication that my invention is new and cannot be encompassed by Babin. My system has and achieves a completely different objective. I have invented and designed a roof vent system that limits the pressure difference that can occur across a roof. Babin has invented a system that 'releases' or 'relieves or 'equalizes' the pressure difference across a roof.

10/068935

TITLE OF THE INVENTION

A ROOF VENT SYSTEM WHICH PREVENTS ROOF LOSS / LIFT OFF IN HIGH WINDS

Inventor: St.Jean Orridge

CROSS-REFERENCE TO RELATED APPLICATIONS

this category

6,484,459 B1	11/2002	Platts
4,144,802	03/1979	Babin

not present in previous submission

FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

Not Applicable

category/headings not present in previous submission

BACKGROUND OF THE INVENTION

paragraph1.

1. Field of the invention:

This invention relates to the effects of high winds (hurricanes and tornadoes) on the roof structures of buildings. It is an invention for a roof vent system, which prevents roof loss due to high wind events. It does this by limiting the pressure difference that can occur across the roof of the structure to a set value. The system is made of simple components, which are inexpensive and do not compromise the system's effectiveness as they age. As such it addresses in a cost effective and quantitative manner, the problem of roof loss that is associated with high-speed winds.

paragraph2.

2. Related art:

The related art (Babin, 4,144,802...03/1979 and Platts 6,484,459...11/2002) also deals with roof vent systems. One facet of Babin's system is that it uses vents to release, relieve or equalize the pressure differences that can develop across a roof during high wind events. The downfall of this system as I see it is that whilst equalization, relief or pressure release occur, the system does not prevent pressure differences from developing which might be sufficient to lift off the roof.

The Platts, system is designed to drop the pressure inside the building to help protect the roof, but it does not ensure that the interior pressure drops at a sufficient rate to prevent a pressure difference developing across the roof that is sufficient to lift off the roof. Again, it is not designed to absolutely limit the pressure difference that can occur.

categories and content not present in previous submission

DETAILED DESCRIPTION

SUMMARY

paragraph3.

This system works by limiting the pressure difference that may occur across a roof. Initially, a quantification of the greatest pressure drop that can possibly occur above a roof per unit time must be arrived at. (Data must be collected from hurricane and tornado events). Next the allowable pressure difference that may occur across the roof must be measured (the allowable pressure difference is less than the pressure difference required to lift off the roof). This allowable pressure difference acts as the maximum potential driving force for air evacuation from the interior of the building. It also dictates the parameters within which the building's internal pressure curve must follow the external curve. Finally the volume of the building must be measured. From this the mass of air that must be evacuated to keep the internal pressure curve within the set acceptable pressure difference from the external curve can be quantified. An equation which provides the area of open venting required to evacuate a given mass of gas has been written. Thus a solution for the minimum vent area required can be arrived at.

added content

content removed that was in previous submission

paragraph4.

In the simplest sense, a known force is expelling a known quantity (mass) of air from an enclosed space. It must be done within a set time limit. Thus the value of the minimum area of venting required to achieve this can be solved for.

added

word changed

added word

the one absolutely accurate equation that replaces the three less accurate ones mentioned in previous submission

DRAWINGS

Graphical representation of the distinction between using a vent to equalize pressure and my vent system which prevents a specific pressure difference from occurring (arbitrary values and units used)

Fig 1a

Use of vents to equalize pressure

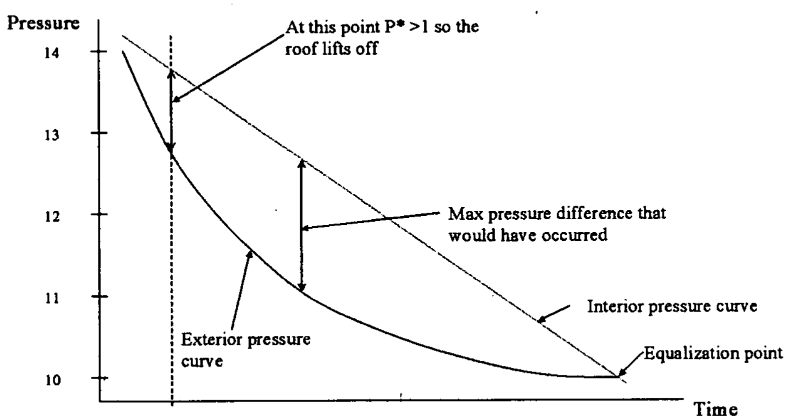


Fig1b

Use of vents to limit the pressure difference across a roof

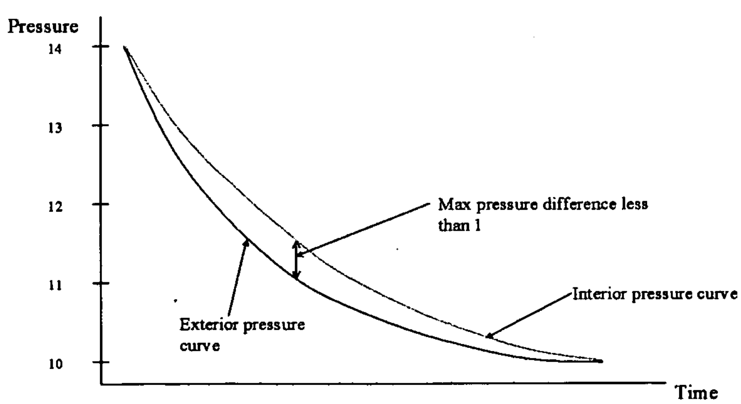


Fig 2

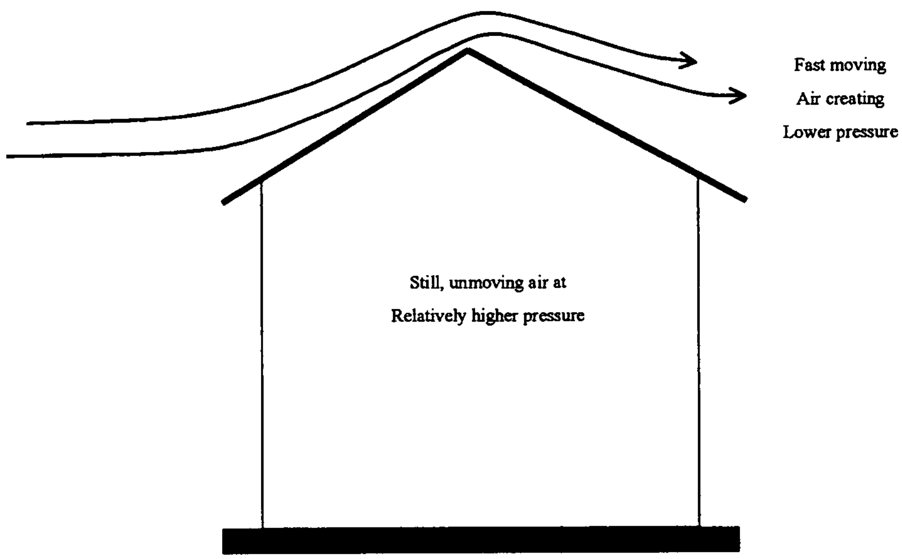


Fig 3

Forces Diagram

The weight of the walls and concrete pad can add to the effective roof weight depending upon the tensile strength of the connections (e.g. nails, screws, brackets, hurricane clips, roof beams)

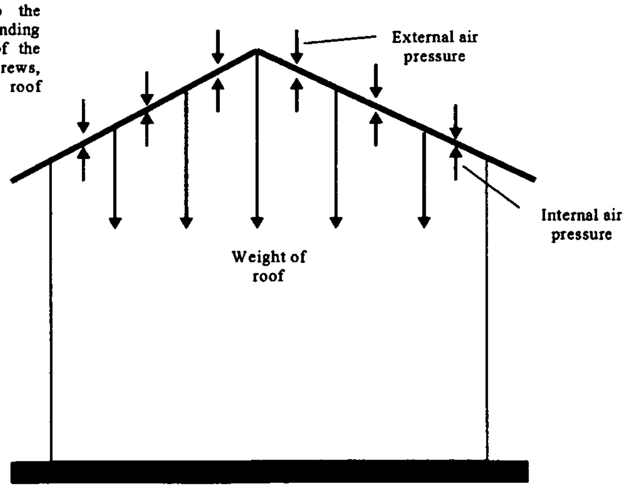


Fig 4a

1) Vent design (A)

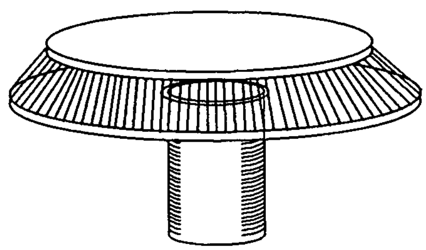


Fig 4b

Cross-sectional view

Plug in closed position

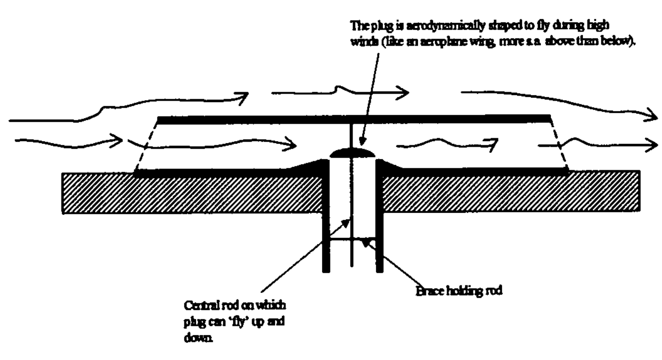


Fig 4c

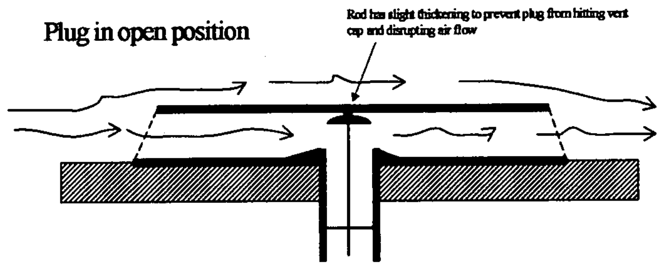


Fig 4d

Details of plug shaft and brace mechanism

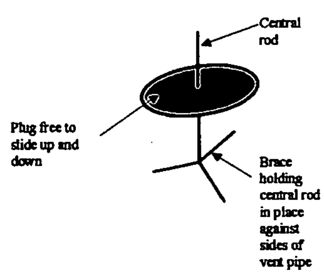


Fig 4e

View from above

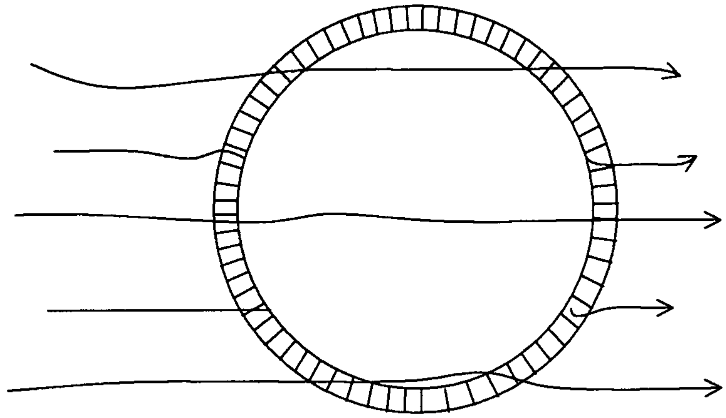
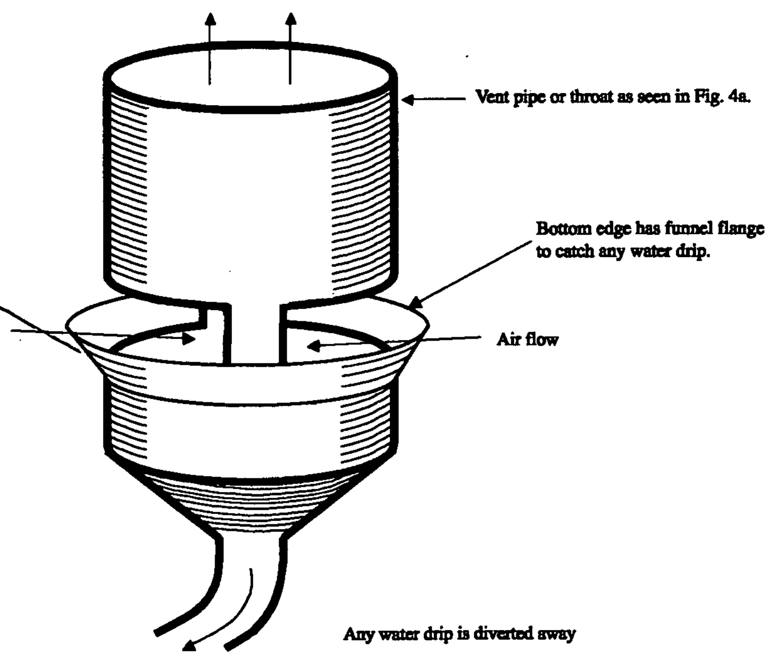


Fig 4f



flange drawn in wasn't in previous submission

Fig 5

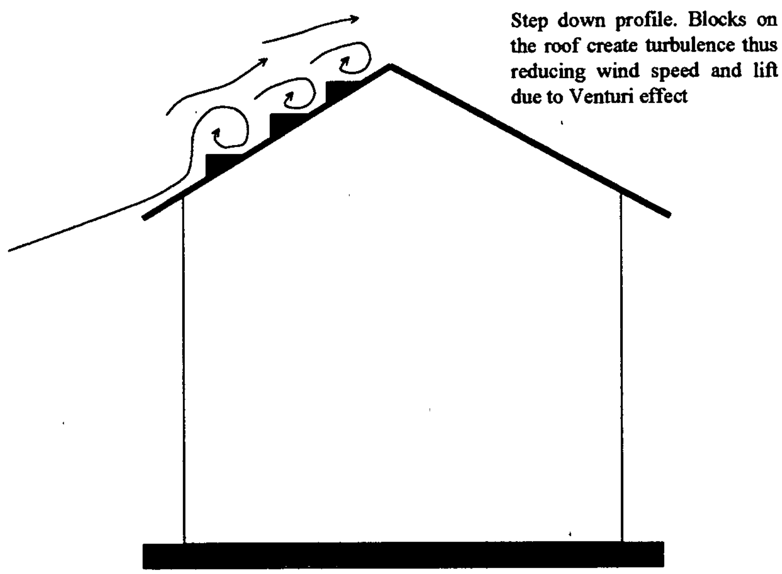

Step down profile. Blocks on the roof create turbulence thus reducing wind speed and lift due to Venturi effect

Fig 6a

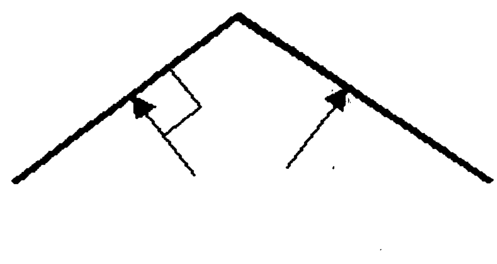


Fig 6b

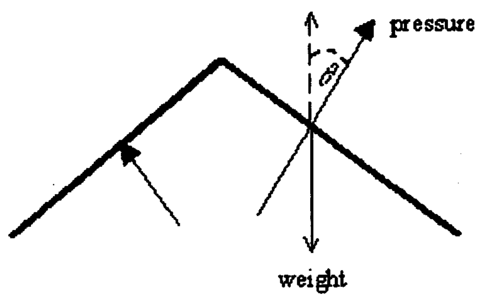


Fig 7

Demonstration Graph (straight line example) of Exterior and Interior Pressure Changes

(exterior pressure is from worst case scenario data)

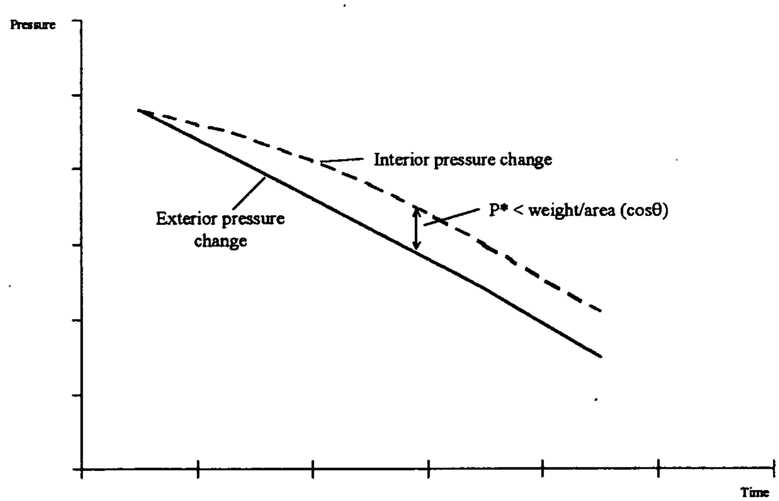
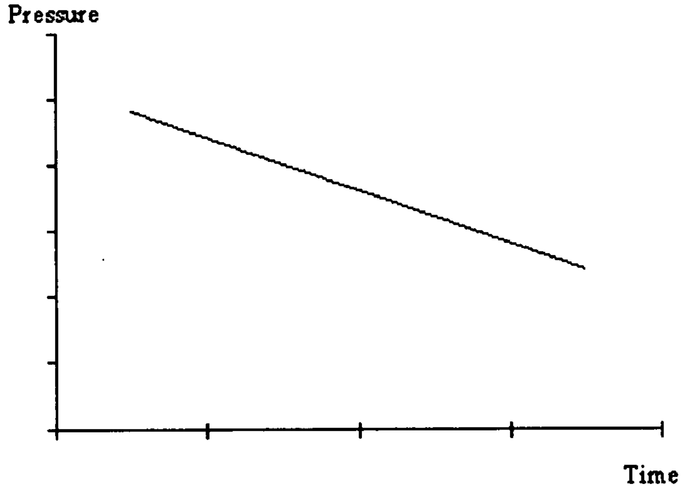
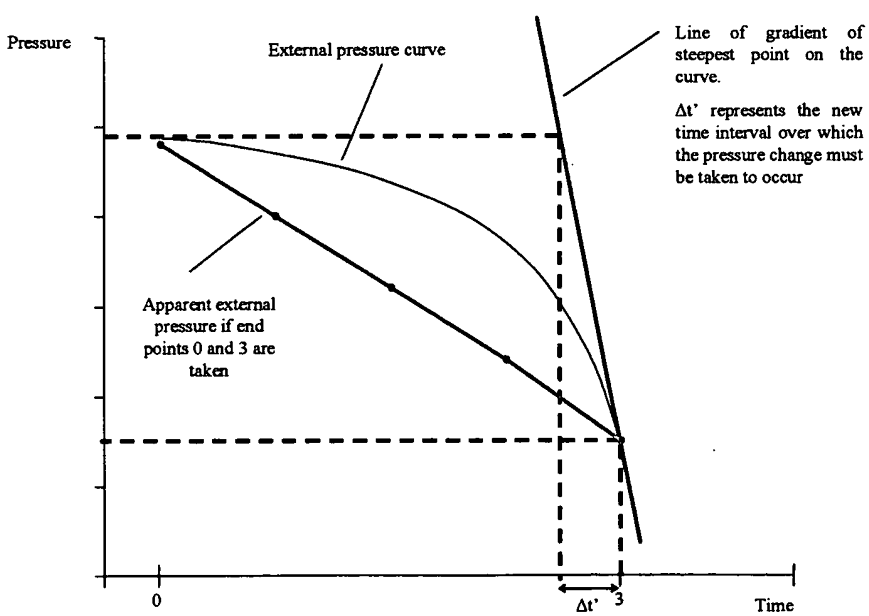


Fig 8



Pressure
Time

Fig 9



Pressure
External pressure curve
Line of gradient of steepest point on the curve.
Δt' represents the new time interval over which the pressure change must be taken to occur
Apparent external pressure if end points 0 and 3 are taken
0
Δt'
3
Time

Fig 10a

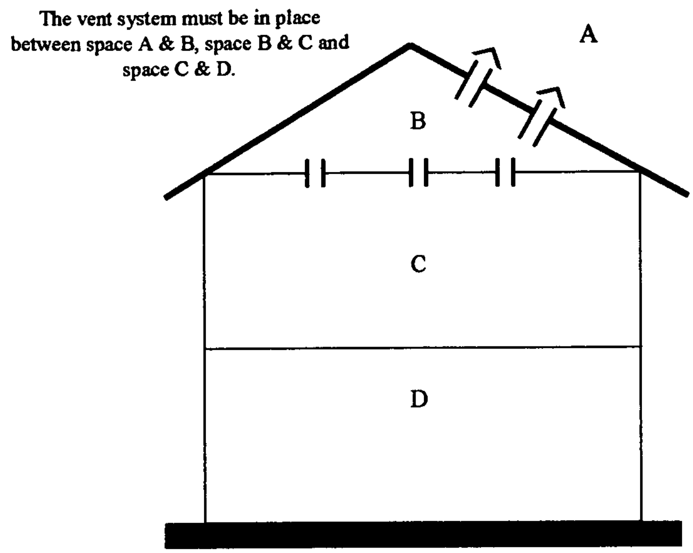


Fig10b

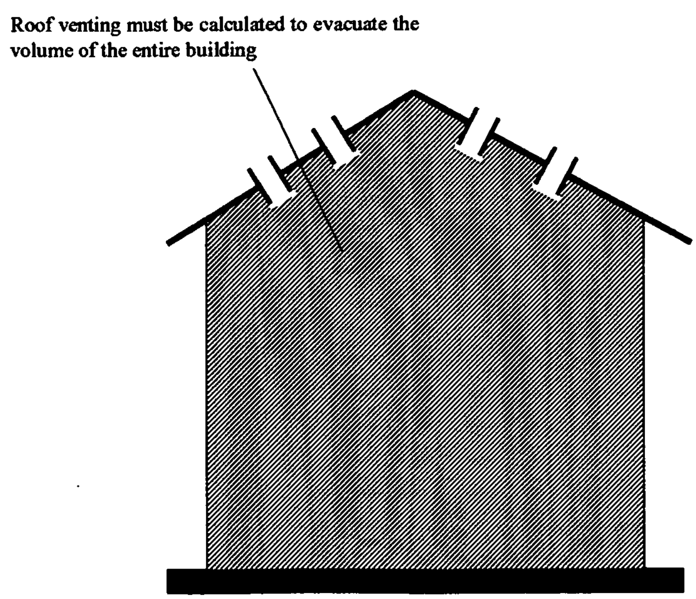


Fig 10c

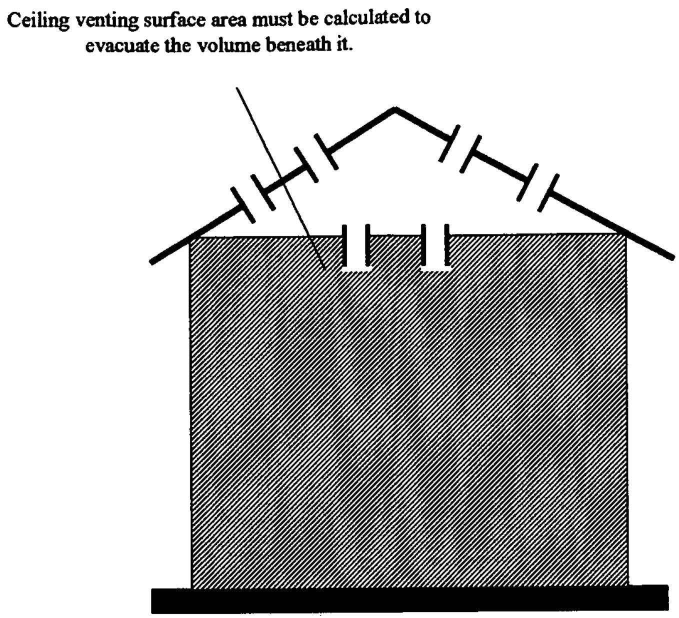


Fig 10d

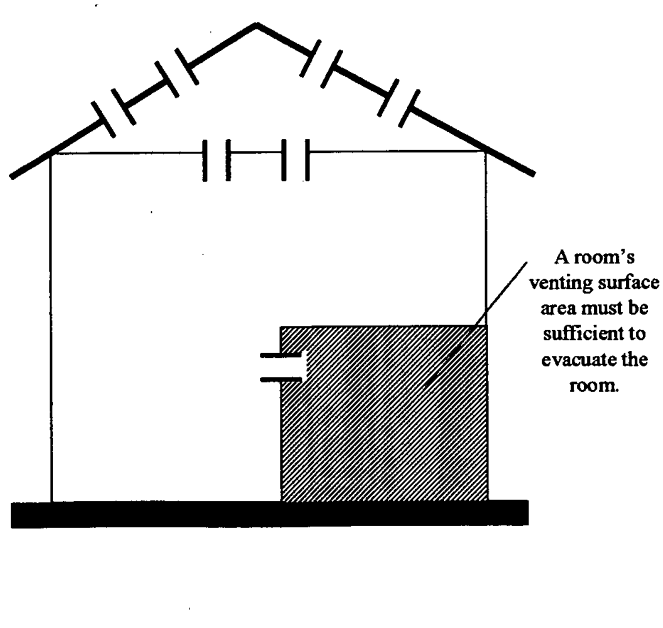


Fig 11

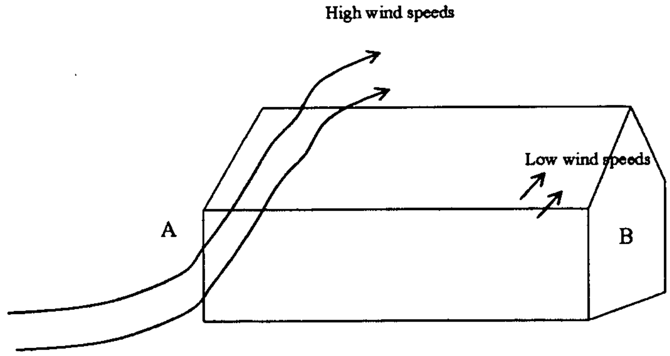


Fig 12

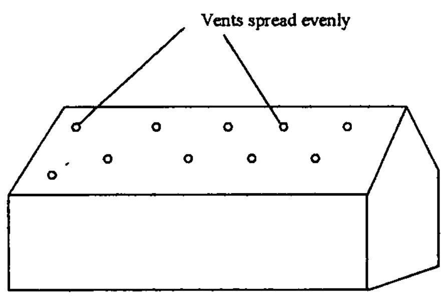
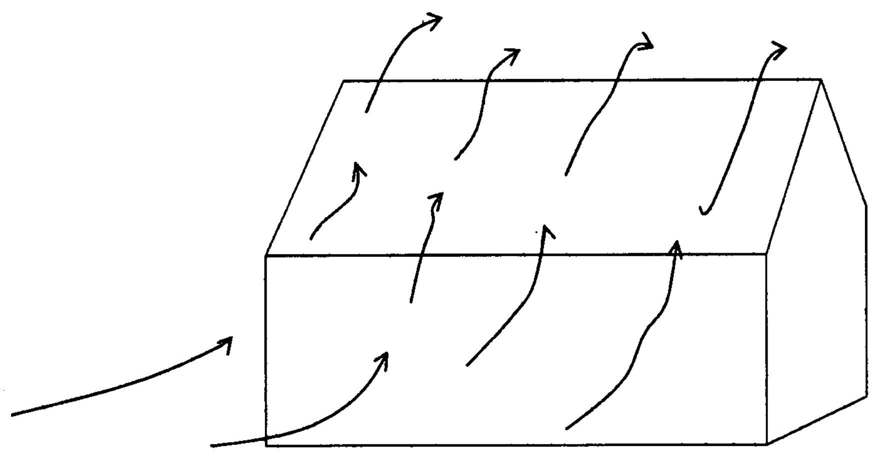


Fig 13



DESCRIPTION OF DRAWINGS

paragraph5.

Fig 1a and Fig 1b: These are graphical representations highlighting the difference between roof vent systems that release/relieve or equalize a pressure difference and my system, which actually limits the possible magnitude of the pressure difference across a roof.

Fig 2: Illustrates air movement above and below a roof.

Fig 3: Illustrates the forces acting on a roof.

Fig 4a through 4f: These figures outline the design of the preferred vent type.

Fig 5: Illustrates a step down profile roof.

Fig 6a: Illustration of the angle at which pressure acts against the interior of a roof.

Fig 6b: Illustration of the weight versus pressure angle of action on a roof.

Fig 7: Graphical representation of a useful interior/exterior pressure change relationship.

Fig 8: Graphical representation of straight line pressure change.

Fig 9: Graphical demonstration of how this applies to non-linear pressure change.

Fig 10a through 10d: Illustrations highlighting how the venting area must be just sufficient to evacuate air from each room of a building.

Fig 11: Illustration of how wind shear will affect the venting density.

Fig 12: Picture of vents spread evenly across the roof area.

Fig 13: Diagram illustrating the fact that when the wind blows from certain directions only a portion of the roof may be exposed to high wind exerting a venturi effect.

this format not used in previous submission (drawings are amongst text.

DETAILED DESCRIPTION OF INVENTION

FORCES ACTING ON A ROOF

paragraph6.

As fast flowing air passes over a roof, there is a resulting lowering of pressure (Venturi effect and turbulence) See Fig 2 . Thus the pressure outside the building (above the roof) is lower than the pressure inside the building (below the roof). Pressure is a force/unit area. In order for the roof to lift off of a house the forces acting upwards must be greater than the forces acting downwards See Fig 3.

word changed

word changed

In the simplest equation format, if

$$\left[\frac{\text{Weight of Roof}}{\text{Unit Area}} + \text{External Pressure} \geq \text{Internal Pressure}\right]$$

then a roof will always stay on. There is no net force upwards.

word added

words added

paragraph7.

It should be possible to quantify with a rough degree of accuracy, using a conservative value the minimum tensile strength of the connections linking the roof to the walls as well as the minimum tensile strength of the roof material itself. These factors can then be incorporated into the above equation to give a more accurate (although less conservative) value for the maximum allowable pressure difference.

word added

words added

$$\frac{\text{Weight of Roof}}{\text{Unit Area}} + \text{Tensile strength of connections} + \frac{\text{External Pressure}}{\text{Unit Area}} \geq \frac{\text{Internal Pressure}}{\text{Unit Area}}$$

$$\frac{\text{Weight of Roof}}{\text{Unit Area}} + \text{Tensile strength of connections} \geq \frac{\text{Internal Pressure - External Pressure}}{\text{Unit Area}}$$

paragraph8.

These equations illustrate that the air pressure difference between the interior and exterior of the building acting upwards must at all times be less than the weight/area of roof plus the factored effect of the tensile strength of connections and roofing material acting downwards.

paragraph9.

In order to allow air to flow across the roof and thus control this pressure difference vents are used.

PREFERRED VENT DESIGN

paragraph10.

words added

Ideally one wants the vent design to be as streamlined as possible so that the air passing through the vent is traveling at the same speed and creating the same lift effect as the air flowing over the adjacent roof. Wind tunnel tests that quantify the friction of air flowing through the vents will allow if necessary a compensating adjustment of the calculated minimum venting area required. (This friction is that experienced by the air passing in under the vent cap and out the other side, not the air moving from the interior of the building through the vent to the exterior.)

paragraph11.

Vent design See figs 4a through 4f.

letter (A) omitted

Vent Performance Points

1) Cap prevents rain from entering, (even most horizontally blown rain).
2) Cap is smaller than base plate so that bars slope in. This makes it more difficult for blown debris to catch on the vent.
3) Vertical bars are spaced such that the gap size doesn't allow bees access. (vents cannot become hive sites)
4) Any water that does enter the vent shaft is collected and channeled through a tube into the drains. The tube might alternatively direct the water outside the building, if this proves easier.

changed wording

5) The central plug is 'free floating' on a central shaft. It is designed to be lifted by high speed winds and its weight / area is low enough to ensure that it will be lifted and the vent is open by the time that the maximum allowable pressure difference is reached.
6) Once the central plug is pushed up it acts like an airplane wing. Air rushing through the vent 'flies' the central plug up on its shaft. The vent stays open as long as high-speed winds are blowing through it. When the wind speed drops the plug sinks down to close the vent.
7) The central plug is built with a small single direction flow valved hole, the valve flow direction being from outside towards the inside of the building when said plug is closed (the purpose of this valve being to allow air to 'leak' back into the building when the vent is closed).

point added

This preferred vent design will only be open in hurricane/tornado conditions. The rest of the time it will remain shut.

Vent B option completely removed

CONSIDERATIONS OTHER THAN VENTS

paragraph12.

1) Increasing the weight of the roof will make it more difficult to lift off (e.g. attach weights to rafters, or the plywood roof sheeting). The disadvantage to this however, is that in the event of a building collapsing during a storm, as materials such as wood or metal weaken with age, rust, termites or rot there is the potential for a lot of heavy weight landing on someone.

words added.

paragraph13.

i. Decreasing wind speed over the roof. (I am not convinced that it would be possible to effectively limit wind speed by creating a certain roof profile)
   See Fig 5

paragraph14.

ii. ~~Increasing the tensile strength of roof connections~~ and roofing materials. This should be somewhat effective however it does have drawbacks:
   a) ~~It can be expensive to rebuild~~ houses with higher quality and greater tensile strength materials. There is also decreasing reliability as metals oxidize and weaken, and wood tensile strength may deteriorate through dry rot or termite action. (Both these factors are difficult to quantify exactly so the real tensile strength may be tough to pinpoint)
   b) This approach does not act to remove/limit pressure stresses it 'fights' them. Thus whilst the edge of a roof may be secured, if there is a weak point of attachment in the center or any weak point anywhere the intense pressure differences are still there to exploit the weak link and thus roof loss may still occur

re worded

paragraph15.

Each methodology has its distinct advantages and drawbacks. I believe however that the cheapest, most durable and most comprehensively effective way to prevent a building from loosing its roof will prove to be the vent system approach. Putting in vents is extremely cheap. Vents are really just an open empty hole for air to flow through and this does not 'decay' over time. (Homeowners need only ensure that come hurricane/tornado season their vents are not plugged for any reason) Finally, vents offer a quantified approach which actually limits the forces at play across the roof. A quantifiable solution is something which is extremely desirable for problems of this nature.

re worded with further elaboration

THE USE OF VENTS, A CALCULATED NUMBER (SURFACE AREA OF OPEN VENTING) WITH RESPECT TO VOLUME OF BUILDING.

paragraph16.

In order to calculate the surface area of open venting (number of vents) that a given building requires to prevent roof loss the following series of steps must be taken.

i. The greatest pressure drop per unit time that can occur above a roof must be quantified.

ii. The pressure difference across the roof that is allowable for each type of roof construction must be measured (i.e. the pressure difference that a given type of roof will tolerate before it is blown off).

iii. Using the information from A and B the pressure change (drop) per unit time that must occur inside the building can be quantified and the venting area required to achieve this can be calculated.

roundabout
excessive explanation removed,
A) shorter more succinct wording substituted

paragraph17.

A continuously recording pressure-sensing device must be set up on roofs in various high wind events (hurricane, tornado). This will provide data of actual worst case scenario pressure changes which must be dealt with above a roof. (This type of data may already have been generated and must simply be referenced).
The data generated may be in the form of a straight line graph (see fig. 8) as pressure changes between two time points or a curve. In the instance where it is a curve it is important to take the gradient of the steepest point of the curve (see fig. 9).

paragraph18.

If Equation C (which follows) is used with a curve such as that in fig 9 and the end points t = 0, t = 3, are used the predicted vent surface area required will correspond to the straight-line pressure change. P^* will go above its preset constraint and so will not truly represent a maximum allowable P^*. To get a solution for vent surface area which maintains the maximum allowable P^* the point which is the steepest gradient of the curve must be taken. Using that gradient line, extrapolate to your time end points and use this as your worst case pressure change value to substitute into Equation C. The vent area calculated from this will be the minimum required to absolutely ensure that the P^* designated represents a maximum allowable P^* and stays within its set constraint.

reworded from previous submission

paragraph19.

It is perhaps important to note that rating a building for a certain wind velocity is misleading as a rating standard. This rating is done in a wind tunnel where air speed is gradually increased to a certain value. This means that the pressure drop associated with high speed wind above the roof is also gradual. Any minute gaps in a model building's

words inserted

joints, which are inevitable in any construction, will allow an opportunity for the relatively higher-pressure air inside the model to be drawn out. ~~Thus as long~~ as the air velocity increase above the roof is gradual, the roof may not lift off. A more accurate rating is only achieved when worst-case pressure drops per unit time are quantified (i.e. maximum wind accelerations and their maximum duration). If wind velocity is the only yardstick used one might find that a roof will withstand gradual wind speed increase up to 140mph, but a sharp gust between 40mph and 90mph is sufficient to lift off the same roof. value changed

word change

paragraph20.

From A) the maximum pressure change that can occur in the shortest period of time above a roof is known. Therefore one knows what pressure change must occur inside the building to prevent a pressure difference (P^*) between the inside and outside of the roof sufficient to lift the roof off.

word insert

<u>B)</u>

paragraph21.

The pressure difference between the inside and outside of the building must at all times be below a certain value. That value is the one at which point the roof will lift off. As explained earlier this value can be calculated very accurately using the weight of the roof/unit area, and a conservative value for the tensile strength of attachments to walls, wall weight etc. However, one could also just build in a safety margin and make the maximum allowable pressure difference the weight/area of the roof ($^4/_5$ weight/area or $^3/_4$ i.e., whatever safety margin one chooses to create).

inserted

I will show scenarios using the weight/area of the roof as the allowable pressure difference.

one line omitted

It should be noted that pressure acts perpendicularly to a given surface. <u>See fig 6a</u>

So in the case of a roof the pressure acts perpendicularly to the roof surface whereas weight acts directly downwards. <u>See fig 6b</u>

Thus more accurately the pressure difference (P^*) must be less than the weight/area ($\cos\vartheta$) to prevent roof loss.

Pressure inside - Pressure outside = P^*

P^* must be less than roof weight/area ($\cos\vartheta$).

$P^* <$ weight/area ($\cos\vartheta$).

<u>C)</u>

reworded

Knowing the exterior pressure change (worst-case scenario data) one knows what the interior pressure must match to stay within the allowable P^*.

See Fig 7

The above graphically defines what the interior pressure curve must be to be useful (i.e., prevent roof loss). Now it is necessary to calculate the area of roof venting (number of vents) necessary to achieve this.

paragraph22.

The first step in this process is as follows: ← newly inserted

1) Calculate the number of moles of gas (air) which must be removed from the interior of the building to keep the pressure difference within the allowable P^* at the point of lowest external pressure (max wind velocity). The interior of the building can be treated as a closed system, and the ideal gas equations can be applied.

word change

Using the gas equation PV = nRT

P = pressure	n = number of moles	
V = volume	R = gas constant	T = temperature

I will be using the sign ↓ to indicate a known value
The initial interior pressure = initial exterior pressure.

The external maximum pressure change quantified in section A) does not have set starting and finishing values. The measured value represents only a maximum pressure change, which can be encountered. In a building with fixed volume, where R is a constant and T can be measured and set, it does not matter what starting point is taken. Whatever your starting pressure, if the maximum potential pressure change is subtracted from this, the number of moles to be evacuated is always the same. (Within the constraints of the ideal gas equations).

word insert

rewritten

rewritten

Volume of building is known
R is the gas constant
T (Temperature) can be set at a typical value for a high wind event in that region. (To be on the safe side, set the temperature at a lower value than it is ever likely to be. This will make the n (number of moles) to be evacuated larger than it will ever have to be, i.e. a built-in safety margin).

eP represents external pressure.
iP represents internal pressure.
P_f represents final pressure.
P_i represents initial pressure.
n_f is final number of moles.
n_i is initial number of moles.

re written more succinctly and clearly

Externally (above the roof),
$eP_f - eP_i$ = the worst case scenario pressure change as measured/taken from storm data.

Internally (within the building),
$iP_f - iP_i$ as an absolute value = absolute value of external $eP_f - eP_i$, subtract P^*.

These are known values.

(Equation A)→ $$\overbrace{\left| eP_f - eP_i \right|}^{\downarrow} - \overset{\downarrow}{P}* = \left| iP_f - iP_i \right|$$

$$iP_f \overset{\downarrow}{V} = n_f \overset{\downarrow}{R}\overset{\downarrow}{T}$$

$$iP_i \overset{\downarrow}{V} = n_i \overset{\downarrow}{R}\overset{\downarrow}{T}$$ subtract initial interior pressure from final interior pressure

$$(iP_f - iP_i)\overset{\downarrow}{V} = (n_f - n_i)\overset{\downarrow}{R}\overset{\downarrow}{T}$$

$$(iP_f - iP_i) = \frac{(n_f - n_i)\overset{\downarrow}{R}\overset{\downarrow}{T}}{\underset{\uparrow}{V}}$$

substitute from (equation I)

$$\overbrace{\left| eP_f - eP_i \right|}^{\downarrow} - \overset{\downarrow}{P}* = \frac{(n_f - n_i)\overset{\downarrow}{R}\overset{\downarrow}{T}}{\underset{\uparrow}{V}}$$

$$n_f - n_i = \frac{\left(\overbrace{\left| eP_f - eP_i \right|}^{\downarrow} - \overset{\downarrow}{P}* \right)\overset{\downarrow}{V}}{\underset{\uparrow}{R}\underset{\uparrow}{T}}$$ ←(Equation B)

the less accurate equations I spoke about in original submission have been replaced with these 100% accurate equations

new equation intend

Thus $n_f - n_i = n$ moles of gas which must be evacuated from the building to keep P^* within its set constraints.

This n moles of gas will have a certain mass (i.e., composition of air %N, O_2, CO_2, etc.) which can be calculated.

paragraph23.

<u>Summary of what is known for any given building</u>

(i.e. what has been measured and what can be calculated)

1) The time over which the external (and therefore internal) pressure change occurs and the value of that change (from worst-case scenario data).
2) The number of moles which must be evacuated from the building.
3) The mass of gas which must be evacuated.
4) The P^* (this is measured and set for each given roof).

Now it is possible to write some further equations.

We know that the friction force on a body in fluid resistance as a body passes through a fluid or reciprocally the friction force on a fluid effected by a body as the fluid passes over that body may be written as $f = kv$ for low speeds and $f = kv^2$ for high speeds.

For a given vent in this system P^* is the maximum force that it will encounter and at terminal velocity $P^* = -kv_t^2$. Thus for the vents specified in this system wind tunnel tests where P^* is applied across the vent and v_t is measured will allow a value for k for this specific vent to be measured.

again these 100% accurate equations replace the old ones.

$P^* = -k\,v_t^2$ The k and v_t are known/measured values from the specified vent.

$P^* = \dfrac{m\,a}{area}$ m (mass) is known from the n (number of moles) previously calculated.

$P^* = \dfrac{m\dfrac{dv}{dt}}{area}$

$\overbrace{\left(-kv^2\right)}^{\downarrow} = \frac{\overset{\downarrow}{m}\frac{dv}{dt}}{area}$ This equation is true as long as the end points chosen for the integration with respect to v end with v at v_t. This makes sense as v must go to v_t for P^* to be reached, and any pressure difference less than P^* is no threat to the roof.

$$area = \frac{\overset{\downarrow}{m}}{\underbrace{\left(-kv^2\right)}_{\uparrow}}\frac{dv}{dt}$$

New 100% accurate equations replacing all old ones

$$\int area(dt) = \int \frac{\overset{\downarrow}{m}}{\underbrace{\left(-kv^2\right)}_{\uparrow}}(dv)$$

$\left[area(t)\right]_o^{\overset{\downarrow}{t}} = \left[\frac{\overset{\downarrow}{m}}{\underset{\uparrow}{k}}v^{-1}\right]_o^{v_t}$ t is the time over which the worst case pressure drop occurs

$$area(\overset{\downarrow}{t}) = \frac{\overset{\downarrow}{m}}{\underset{\uparrow}{k}\,\underset{\uparrow}{v_t}}$$

(Equation C) $\rightarrow \left[area = \frac{\overset{\downarrow}{m}}{\underset{\uparrow}{k}\,\underset{\uparrow}{v_t}\,\underset{\uparrow}{t}}\right]$ where m is the mass calculated from n moles to be evacuated as taken from worst case pressure drop measurements. k and v_t are the values measured from wind tunnel tests performed on the specific vent type, and t is the time over which the worst case pressure drop occurs.

SOME POINTS FOR OVERALL SYSTEM SETUP

paragraph24.

In many buildings/houses there may be a space below the roof.
See Fig 10a

The vent system must be in place between space A&B space B&C and space C&D.

Between floors a stairway will probably be sufficient surface area (allow sufficient volume flow)

Rooms with doors that might potentially be closed must have vents. One would simply apply Equation C to calculate the surface area of venting necessary to evacuate each room's volume.

new 100% accurate equation)

See fig 10b

See fig 10c

See fig 10d
The flow route may be designed as one wishes, but everything must flow out through the roof in this open, free-flowing vent system.

porch & verandah situations removed. (ideal gas equations do not apply here as enclosed space is not present.

VENT PLACEMENT PARAMETERS

paragraph25.

The area calculated as being the minimum required to ensure that a roof does not blow off could be divided up into many vents, or it could be built as one giant vent. This system is designed to work when the whole roof (and thus the entire minimum required venting) is exposed to the high wind situation.

paragraph26.

PARAMETER 1

The scenario depicted below shows a situation that represents the system's first modification parameter.

Reworded

reworded and ordered clearly

The pressure decrease due to high winds only occurs where there is high-speed airflow. If wind speeds are high at A and very low at B, a vent where low wind speeds occur does not experience a pressure difference that would contribute to the evacuation of the building's air. There is also of course no lift force exerted on the roof at this point and thus no need to evacuate air to effect a limitation of pressure difference for that part of the roof. However, at point A where high-speed winds are blowing, the entire minimum venting area required would need to be present. (This assumes that it is possible to experience a worst-case scenario pressure drop at one end of the roof and no pressure change at the other.) In order to quantify the possibility of, and if necessary effect control of this situation, wind sheer data from storm events must be collected. This wind sheer data would give a value for the shortest distance over which winds blowing at high speeds and winds blowing at low speeds could be simultaneously measured. (Wind sheer) This distance, if it should be small enough, (e.g. 30 feet) would be used as a guide. The building's entire calculated minimum vent area (as per Equation C) would have to be installed every 30 feet. If the distance was 500 yards then this adjustment would not be necessary as very few buildings are that long. (The distance value will depend upon the wind event that the building is being rated for, tornadoes will tend to have a greater wind sheer potential)(See fig 11)

paragraph27.

PARAMETER 2

reworded and ordered clearly

It is also important that the profile of a given building be studied. The calculated area of venting required to keep the roof on, must be the area of venting exposed to high winds, regardless of their direction. (The positive effects on air evacuation of the pressure drop on the turbulent drag / leeward side of the building are discounted, they represent a safety margin).

The design of the above building means that the minimum possible roof surface area exposed to high wind is ½ of the total roof surface area. The calculated minimum surface area of venting required, must therefore be present on both sides of the roof.

It is apparent that the house profile must be studied, and the direction from which the wind blows over the least roof surface area ascertained. That roof surface area must have the calculated necessary area of venting to prevent roof loss. The same formula must be

applied to every wind direction and related windward roof surface area exposed (see fig13).

paragraph28.

PARAMETER 3

As a general guideline, it is better to have the minimum required venting area divided into several vents and spread evenly across the roof. (See fig 12)(Studies have been done, which map the intensity of pressure drop on different sections of a roof. Using this data, zones of highest-pressure drop could be given a proportionately higher concentration of vents. The report that I viewed however, involved tests done on a horizontal shed like roof and data from all common roof angles would have to be generated and analyzed before optimal vent concentration patterns could be designated.)

re worded and ordered clearly

CLAIMS

Different and varying embodiments may be taught within the scope of the inventive concept that I have put forward here. As such the descriptive detail required by the law is to be taken as illustrative and not applied in a limiting sense.
I claim as my invention:

4) A roof vent system that acts and has as its objective to distinctly limit the pressure difference that can occur across a roof to a set value, the system being comprised of the following components and built to the following equation specifications and design parameters:
    a. vents which pass through the roof, connecting the interior of the building with the outside atmosphere such that air may flow freely between the interior and exterior of the building;
    b. equations into which are input data for the worst-case scenario pressure change above a building, the volume of the building and the pressure difference across the roof (across a roof meaning between the interior and exterior of a building) that the roof components of the specified building will tolerate, these said equations with said mentioned data providing a specific solution for the area (number of vents required) for the system to perform its objective of pressure difference limitation to a desired and set value in each application, said roof vent system's structure being specified and built according to the output of these equations (see Equation C);
    c. the first parameter incorporating wind sheer data which is applied to the area solution provided by the area equation referred to in b. above, to give the compensated value for the final required venting area solution, with the roof vent system area and structure being specified and built in accordance with the dictates of this parameter;
    d. the second parameter is applied such that the calculated area of venting from b. and c. must be placed such that said venting area is 'visible' to winds blown from each and every direction, (i.e. the calculated venting area is exposed to windward for all wind directions), this parameter being the next defining specification for the construction of the roof vent system;
    e. the third parameter which takes the area of venting dictated by b. c. and d. and spreads its standardized component vents evenly across the specified roof areas, provides the final specification for the structure of the complete roof vent system as written in claim 4);

the structure of the roof vent system claimed in 4) is defined by the specifications a. through e. and must be built according to those specifications in order to perform its stated objective and inventive initiative of pressure difference limitation.

re written

5) The use of the following specified vent apparatus as a pressure limiting tool in the over-all roof vent system as expressed in claim 4), the vent apparatus details being as follows:

rewritten

a. a vent which is comprised of a cylindrical tube that passes through the roof and acts as the means for connection and allowance of air flow between the interior and exterior of a building (see fig 4a), said vent cylindrical tube being attached by means of a bracket to said building's roof beams, (or other such support structure as is deemed suitable), furthermore a drain tube for the collection and removal of any water that does enter the vent runs from the lower end of the cylindrical vent body tube into the drains (or to the ground outside the building if this proves more convenient) (see fig 4f);
b. said vent structure also comprises a circular base plate and vent cap which are fixed parallel to each other and sit atop the roof, the said base plate sits flush with the roof (see fig 4a, 4b and 4e), the said cap attached above the said base plate to the said base plate, has the purpose of preventing rain from entering the vent mouth, a ring of vertical bars separate these two plates and the cap is smaller than the base plate such that the bars slope inwards from base plate to cap, (this is intended to inhibit blown debris catching on the vent), the said vertical bars are spaced such that the gap size between the bars doesn't allow bees access, (vents cannot become hive sites {see fig 4a});
c. the vent end opening to the exterior of the building is closed by a plug, (see figs 4b, 4c and 4d) the plug is open in high speed winds and closed when there is no wind present, the said plug is 'free floating' on a central shaft, the said plug being of a correct weight to be opened by a pressure difference less than the roof's designated P^* value, the said plug is a disc that has the cross-sectional shape of an airplane wing such that once pushed open the said plug is lifted by high speed winds, keeping the said vent open as long as high speed winds are blowing through the said vent, in addition the said plug is built with a small single direction flow valved hole in it (the valve flow direction being from the outside towards the inside of the building).

ABSTRACT

paragraph29.

This disclosure is about a roof vent system that acts to limit the pressure difference that can occur across a roof due to the effects of high wind. Equations that relate the worst-case scenario pressure drops above a roof with the volume of the building are used to generate a specific venting area required for each structure. This venting area will act to limit the pressure difference that can occur across that roof to a set value. This represents a quantifiable solution using vents in a system to achieve the particular objective of pressure difference limitation. The disclosure describes the development of these equations and details the preferred vent design. Vents are cheap and easily installed as a retrofit into existing buildings making this quantified venting system the simplest, most certain, and most cost effective means of preventing roof loss in high wind events.

re worded

SEQUENCE LISTING

Not Applicable